**Unit Overview - Molecular Genetics**

**Big Ideas**

D1. analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology

D2. investigate, through laboratory activities, the structures of cell components and their roles in

processes that occur within the cell

D3. demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.

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| --- | --- | --- | --- |
| **Lesson Title and Topic**  **Expectation Codes** | **Lesson Strategy and Assessment** | **Timing** | **Evaluation including criteria addressed from Achievement Chart** |
| Day 1  **Title**: Introduction into Molecular Genetics and Major Scientific Contributors (D3.7)  **Topic**: | Detailed Overview   * *Learning Strategy*: Conference/debate and role play * Students will cover various scientific discoveries through group conferencing. This conference requires students to role play different scientists who contributed in molecular genetics and participate in a discussion. Students are also asked to pose their views on molecular genetics (ethical or theoretical). * Introduction to the unit of Molecular Genetics - Video: NOVA - Instructions of a Human Being http://www.pbs.org/wgbh/nova/genome/program\_t.html * *Note:* only part 1 of a 16 part video will be watched but it is up to the discretion of the teacher     Assessment Strategy   * *Diagnostic Assessment* for feedback * *Peer Assessment* – students will peer assess the strength of the argument and how their response can be approved. | 50 minutes  10-15 minutes | **Knowledge** – Scientific discoveries by Frederick Griffith, Watson and Crick and Hershey and Chase  **Communication** – How well students communicate their ideas to their peers by using appropriate terminology and supported evidence  **Application** – How well students can formulate a viewpoint |
| Day 2  **Title**: DNA Repair and Replication (D2.1; D3.1)  **Topic**:   * Process of DNA * Complimentary Strand Formation * DNA repair | Detailed Overview   * *Learning Strategy:* PowerPoint or Overhead lecture with handouts * DNA model and DNA replication will be covered. Terminology and processes will be discussed in detail as well as the repair mechanisms for DNA sequencing * Introduce culminating task (D1.1 and D1.2): briefly review the expectations of the assignment and deadlines | 45 minutes  20 minutes | **Knowledge -** students will be asked to complete a fill in the blank handout outlining the processes encompassing DNA. This will be a homework check as DNA is the foundation for the rest of the unit |
| Assessment Strategy   * *Anecdotal Records* of who is actively participating in class discussion |  |
| Day 3  **Title**: (D3.2; D2.1)  **Topic**: | Detailed Overview   * Mini review of DNA * *Learning Strategy*: Lecture and concept mapping * Lecture component: material will be taught directly to the students; students will also understand the process of protein synthesis and the roles of DNA and RNA * Concept mapping: students will then be asked to compare and contrast RNA and DNA form and function via a Venn Diagram | 10 minutes  30 minutes  30 minutes | **Knowledge -**  **Communication** |
| Assessment Strategy   * *Checklist* to ensure that all criteria are met |  |
| Day 4  **Title**: (D2.2; D2.4)  **Topic**: | Detailed Overview   * Students will practice DNA and RNA base pairing to build a polypeptide. Students will also answer questions on transcription and translation and the central dogma of molecular biology. *http://www.lessonplansinc.com/lessonplans/protein\_synthesis\_ws.pdf* * *Learning Strategy:* Students will investigate the processes involved in protein synthesis through *Gizmo simulation* called *RNA and Protein Synthesis* [*http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=442*](http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=442) | 25 minutes  45 minutes | **Knowledge** |
| Assessment Strategy   * *Peer Assessment:* Students will correct each other's worksheets the next day |  |
| Day 5  **Title**: (D3.3)  **Topic**: | Detailed Overview   * Take up "Protein Synthesis Worksheet" from the day before * *Learning Strategy*: Lecture encompassing a question and answering session of genetic expression and protein synthesis in eukaryotes and prokaryotes by regulatory proteins * \*\*\* Remind students that the following period will be used for the culminating task in the computer lab | 10 minutes  45 minutes |  |
| Assessment Strategy   * *Anecdotal Records* through Q&A period. The teacher can gauge how well the information was retained. |  |
| Day 6  **Topic**: Culminating Task (D1.1 and D1.2) | Detailed Overview   * Students will be working independently on the culminating task | 75 minutes | **Knowledge**  **Inquiry** |
| Assessment Strategy   * *Scoring rubric/Checklist* for work ethic |  |
| Day 7  **Title**: Mutation (D3.4)  **Topic**:   * Types of Mutations * Causes of Genetic Mutation * Cancer | Detailed Overview   * Learning Strategy: Lecture on the types of mutations namely: silent mutation, missense mutation, nonsense mutation, frame shift mutation, etc.; how are they cause and their impact on the body; example: cancer |  |  |
| Assessment Strategy |  |
| Day 8  Title: (D3.5)  **Topic:** | Detailed Overview   * *Learning Strategy*: Guest Speaker to discuss on genetic modification in its applications to industry and agriculture |  |  |
| Assessment Strategy   * Response journal on the guest speaker’s presentation |  |
| Day 9  **Title:** (D3.6)  **Topic:** | Detailed Overview   * *Learning Strategy*: |  |  |
|  |  |
| Day 10  **Title:**  **Topic:** | Detailed Overview   * LAB PART 1 |  |  |
| Assessment Strategy |  |
| Day 11  **Title:**  **Topic:** | Detailed Overview   * LAB PART 2 |  |  |
| Assessment Strategy |  |
| Day 12  **Topic**: Culminating Task (D1.1 and D1.2) | Detailed Overview   * Students will be working independently on the culminating task | 75 minutes |  |
| Assessment Strategy   * *Scoring rubric/Checklist* for work ethic |  |
| Day 13  **Title:** (D3.6)  **Topic:** | Detailed Overview   * *Learning Strategy:* Field trip to a higher educational institution to learn about the functions of cell components such as restriction enzymes and recombinant DNA that are using biotechnology | 60 minutes |  |
| Assessment Strategy   * 3-2-1 Reflection: Students reflect on three things that they have learned from the field trip, two concepts that are new to them, and one question they still have | 15 minutes |
| Day 14  **Topic**: Culminating Task (D1.1 and D1.2) | Detailed Overview   * Independent group study to finalize their culminating task for presentations | 75 minutes |  |
| Day 15  **Title:** Culminating Task Presentation | Detailed Overview   * Presentations (2 groups - 30 minutes each) | 75 minutes |  |
| Assessment Strategy   * Rubric |
| Day 16  **Title:** Culminating Task Presentation | Detailed Overview   * Presentations (2 groups - 30 minutes each) | 75 minutes |  |
| Assessment Strategy   * Rubric |
| Day 17  **Title:**  **Topic:** | Detailed Overview   * Review Preview * Explain what the review period will entail and how the bell ringer will work * The first batch of students (max 12) will participate in a bell ringer on the basic concepts of the unit * The other half of the class will work independently or in pairs on review. These students are allowed to ask the teacher any questions they may still have on the unit * In these 5 minutes, the second half of the class will swap places with the first half * The second half of the class will partake in the bell ringer, while the first half works quietly * Answers will be taken up by either making an overhead or posting solutions around the room   \*\*Note: See below for Bell Ringer | 10 minutes  20 minutes  5 minutes  20 minutes  10 minutes | **Knowledge**  **Communication**  **Application** |
| Day 18  **Title:**  **Topic:** | Detailed Overview   * Unit Test | 75 minutes | **Knowledge**  **Communication**  **Application**  **Inquiry** |
| Assessment Strategy   * Multiple Choice * Short Answer * Short Essay * Diagram |  |
| Day 19  **Title:**  **Topic:** | Detailed Overview   * Movie - Gattaca | 55 minutes |  |
| Assessment Strategy   * Students are asked to write a short reflection using the concepts and theories they have - during this time students may jot down point form notes | 20 minutes |
| Day 20  **Title:**  **Topic:** | Detailed Overview   * Movie - Gattaca | 50 minutes |  |
| Assessment Strategy   * Students will complete their reflection and hand it in by the end of the period | 25 minutes |

**Molecular Genetic Unit Review - Bell Ringer**

For those students who want to participate the following rules apply:

1) only move stations when the bell rings in a clockwise direction

2) you are not allowed to ask anyone for help

3) at each station you will have two minutes

**Station 1**

**1.  The monomers that nucleic acids are built from are \_\_\_\_\_ and  they contain not only atoms of C, H, O, and N but also \_\_\_\_.**  
**a.** [amino acids; sulfur](http://novaonline.nvcc.edu/eli/biotoday/response61.htm) **b.** [fatty acids; sulfur](http://novaonline.nvcc.edu/eli/biotoday/response61.htm)  
**c.** [bases; phosphorus](http://novaonline.nvcc.edu/eli/biotoday/response61.htm) **d.** [nucleotides; phosphorus](http://novaonline.nvcc.edu/eli/biotoday/response61.htm)

**2.  Wave lengths in the electromagnetic spectrum that are mutagenic are absorbed by**  
**a.** [DNA](http://novaonline.nvcc.edu/eli/biotoday/response62.htm)**b.** [protein](http://novaonline.nvcc.edu/eli/biotoday/response62.htm) **c.** [both DNA and protein](http://novaonline.nvcc.edu/eli/biotoday/response62.htm)**d.** [neither DNA nor protein](http://novaonline.nvcc.edu/eli/biotoday/response62.htm)

**Station 2**

**3.  Which of the following DNA base sequences is complementary to this base sequence:**  
**ACGGATTAG**  
**a.** [TGCCTAATC](http://novaonline.nvcc.edu/eli/biotoday/response63.htm) **b.** [GATTGCCGT](http://novaonline.nvcc.edu/eli/biotoday/response63.htm)**c.** [UGCCUAAUC](http://novaonline.nvcc.edu/eli/biotoday/response63.htm)**d.** [GAUUGCCGT](http://novaonline.nvcc.edu/eli/biotoday/response63.htm)

**4.  Which of the following would represent a mutation?**  
**a.** [a change in the base sequence of DNA](http://novaonline.nvcc.edu/eli/biotoday/response64.htm) **b.** [crossing over in meiosis](http://novaonline.nvcc.edu/eli/biotoday/response64.htm)  
**c.** [both (a) and (b)](http://novaonline.nvcc.edu/eli/biotoday/response64.htm) **d.** [neither (a) nor (b)](http://novaonline.nvcc.edu/eli/biotoday/response64.htm)

**5.  Arrange the following structures/chemicals in order of size from smallest to largest.**  
**a.** codon**b.** gene **c.** base**d.** chromosome

**Station 3**

**6.  A change in which of the following would result in a mutation?**  
**a.** [order of bases in DNA](http://novaonline.nvcc.edu/eli/biotoday/response66.htm)**b.** [gene](http://novaonline.nvcc.edu/eli/biotoday/response66.htm)**c.** [chromosome](http://novaonline.nvcc.edu/eli/biotoday/response66.htm)**d.** [all of the above](http://novaonline.nvcc.edu/eli/biotoday/response66.htm)

**7.  It is possible to insert the DNA from one virus (virus A) into the protein coat of a different virus (virus B). If such a composite virus infected a cell, the resultant viruses produced in the host cell would have DNA like virus \_\_\_\_ and protein like \_\_\_\_\_\_.**  
**a.** [A;B](http://novaonline.nvcc.edu/eli/biotoday/response67.htm)**b.** [A;A](http://novaonline.nvcc.edu/eli/biotoday/response67.htm)**c.** [B;B](http://novaonline.nvcc.edu/eli/biotoday/response67.htm) **d.** [B;A](http://novaonline.nvcc.edu/eli/biotoday/response67.htm)

**8.  The production of a protein from mRNA is called \_\_\_\_\_\_.**  
**a.** [replication](http://novaonline.nvcc.edu/eli/biotoday/response68.htm)**b.** [transformation](http://novaonline.nvcc.edu/eli/biotoday/response68.htm)**c.** [transcription](http://novaonline.nvcc.edu/eli/biotoday/response68.htm) **d.** [translation](http://novaonline.nvcc.edu/eli/biotoday/response68.htm)

**Station 4**

**9.  A sequence of bases is found in some type of nucleic acid.  The sequence is  AUUCCG.  The nucleic acid in question must be**  
**a.** [DNA](http://novaonline.nvcc.edu/eli/biotoday/responsse69.htm) **b.** [mRNA](http://novaonline.nvcc.edu/eli/biotoday/responsse69.htm) **c.** [tRNA](http://novaonline.nvcc.edu/eli/biotoday/responsse69.htm) **d.** [It could be either mRNA or tRNA](http://novaonline.nvcc.edu/eli/biotoday/responsse69.htm)

**10.  In eukaryotic cells, DNA replication takes place in the \_\_\_\_\_\_ and protein synthesis takes place in the \_\_\_\_\_\_\_\_.**  
**a.** [nucleus; cytoplasm](http://novaonline.nvcc.edu/eli/biotoday/response610.htm)**b.**[cytoplasm; nucleus](http://novaonline.nvcc.edu/eli/biotoday/response610.htm)  
**c.** [both take place in the nucleus](http://novaonline.nvcc.edu/eli/biotoday/response610.htm)**d.** [both take place in the cytoplasm](http://novaonline.nvcc.edu/eli/biotoday/response610.htm)

**Station 5**

**11.  Which of the following does NOT occur in DNA replication?  The original double helix**  
**a.** [unwinds](http://novaonline.nvcc.edu/eli/biotoday/response611.htm)**b.** [bonds between base pairs are broken](http://novaonline.nvcc.edu/eli/biotoday/response611.htm)  
**c.** [the unpaired strands split into codons](http://novaonline.nvcc.edu/eli/biotoday/response611.htm)**d.** [all occur](http://novaonline.nvcc.edu/eli/biotoday/response611.htm)

**12.  Some point mutations are called silent mutations, i.e., the mutation does not change the amino acid after the altered mRNA is translated.  This is possible because the genetic code is**  
**a.** [universal](http://novaonline.nvcc.edu/eli/biotoday/response612.htm)**b.** [degenerate](http://novaonline.nvcc.edu/eli/biotoday/response612.htm)  
**c.** [both (a) and (b) are possible explanations](http://novaonline.nvcc.edu/eli/biotoday/response612.htm) **d.** [neither (a) nor (b) are possible explanations](http://novaonline.nvcc.edu/eli/biotoday/response612.htm)

**Station 6**

**13.  If the arrangement of bases on DNA is CATTAG, then a corresponding strand of mRNA will be**  
**a.** [GTAATC](http://novaonline.nvcc.edu/eli/biotoday/response38.htm)**b.** [TGCCGA](http://novaonline.nvcc.edu/eli/biotoday/response38.htm) **c.** [GUAAUC](http://novaonline.nvcc.edu/eli/biotoday/response38.htm) **d.** [UGCCGA](http://novaonline.nvcc.edu/eli/biotoday/response38.htm)

**14. The chemical instructions in DNA are due to**  
**a.** [the way the bases are paired](http://novaonline.nvcc.edu/eli/biotoday/response39.htm) **b.** [the order of the bases in DNA](http://novaonline.nvcc.edu/eli/biotoday/response39.htm)  
**c.** [the arrangement of the sugar and phosphate molecules](http://novaonline.nvcc.edu/eli/biotoday/response39.htm) **d.** [the codons in mRNA](http://novaonline.nvcc.edu/eli/biotoday/response39.htm)

**15. The role of mRNA is to**  
**a.** [carry the genetic instructions to the cytoplasm.](http://novaonline.nvcc.edu/eli/biotoday/response40.htm)  
**b.** [identify and transport amino acids.](http://novaonline.nvcc.edu/eli/biotoday/response40.htm)  
**c.** [provide nucleotides for RNA production.](http://novaonline.nvcc.edu/eli/biotoday/response40.htm)**d.** [produce amino acids for protein.](http://novaonline.nvcc.edu/eli/biotoday/response40.htm)

**Station 7**

**16. Transcription refers to**  
**a.** [DNA replication.](http://novaonline.nvcc.edu/eli/biotoday/response41.htm)  
**b.** [protein synthesis using mRNA and tRNA.](http://novaonline.nvcc.edu/eli/biotoday/response41.htm)  
**c.** [mRNA synthesis from DNA.](http://novaonline.nvcc.edu/eli/biotoday/response41.htm)  
**d.** [converting an inactive protein into its active form.](http://novaonline.nvcc.edu/eli/biotoday/response41.htm)

**17. Which of the following molecules has an amino acid attached to it?**  
**a.** [DNA](http://novaonline.nvcc.edu/eli/biotoday/response42.htm)**b.** [tRNA](http://novaonline.nvcc.edu/eli/biotoday/response42.htm) **c.** [mRNA](http://novaonline.nvcc.edu/eli/biotoday/response42.htm) **d.** [all of the above](http://novaonline.nvcc.edu/eli/biotoday/response42.htm)

**18. Codons may**  
**a.** [act as start codons.](http://novaonline.nvcc.edu/eli/biotoday/response43.htm)  
**b.** [act as stop codons.](http://novaonline.nvcc.edu/eli/biotoday/response43.htm)  
**c.** [code for a specific amino acid.](http://novaonline.nvcc.edu/eli/biotoday/response43.htm)  
**d.** [do all of the above.](http://novaonline.nvcc.edu/eli/biotoday/response43.htm)

**Station 8**

**19. When a DNA molecule replicates, the resulting DNA molecules are correctly described by which of the following?**  
**a.** [Entirely new strands of DNA are made.](http://novaonline.nvcc.edu/eli/biotoday/response44.htm)  
**b.** [Each strand of the DNA molecule contains some old DNA and some new DNA.](http://novaonline.nvcc.edu/eli/biotoday/response44.htm)  
**c.** [Each new DNA molecule contains one old strand and one new strand.](http://novaonline.nvcc.edu/eli/biotoday/response44.htm)  
**d.** [One DNA molecule contains two old strands; the other has two new strands.](http://novaonline.nvcc.edu/eli/biotoday/response44.htm)

**20. How many amino acids are coded for in this mRNA sequence:      GGUACCUUUACU**  
**a.** [12](http://novaonline.nvcc.edu/eli/biotoday/response45.htm)**b.** [6](http://novaonline.nvcc.edu/eli/biotoday/response45.htm) **c.** [4](http://novaonline.nvcc.edu/eli/biotoday/response45.htm) **d.** [1](http://novaonline.nvcc.edu/eli/biotoday/response45.htm)

**21. Thirty percent of the bases in DNA extracted from a prokaryotic cell is adenine. What percentage of cytosine is present in this DNA?**  
**a.** [10](http://novaonline.nvcc.edu/eli/biotoday/response46.htm)**b.** [20](http://novaonline.nvcc.edu/eli/biotoday/response46.htm) **c.** [30](http://novaonline.nvcc.edu/eli/biotoday/response46.htm) **d.** [40](http://novaonline.nvcc.edu/eli/biotoday/response46.htm)

**Station 9**

**22. All cells of a species (except for the sex cells ) contain the same amount of DNA. However, the cells of multicellular organisms vary in both structure and function from one tissue type to another. This specialization is evidence that most of the DNA in a cell is**  
**a.** [inactive](http://novaonline.nvcc.edu/eli/biotoday/response47.htm) **b.** [removed as the cell matures](http://novaonline.nvcc.edu/eli/biotoday/response47.htm)  
**c.** [converted into protein](http://novaonline.nvcc.edu/eli/biotoday/response47.htm) **d.** [converted into glycoprotein](http://novaonline.nvcc.edu/eli/biotoday/response47.htm)

**23. Which of the following is the role of the structural genes in an inducible enzyme system?**  
**a.** [to code for proteins that metabolize an inducer substance](http://novaonline.nvcc.edu/eli/biotoday/response48.htm)  
**b.** [to produce a repressor that binds to the operator](http://novaonline.nvcc.edu/eli/biotoday/response48.htm)  
**c.** [to stop the transcription of the operator](http://novaonline.nvcc.edu/eli/biotoday/response48.htm)  
**d.** [to recognize and form a complex with the inducible enzyme](http://novaonline.nvcc.edu/eli/biotoday/response48.htm)

**Station 10**

**24. Substances that cause cells to increase production of an enzyme (or group of enzymes ) are know as**  
**a.** [introns](http://novaonline.nvcc.edu/eli/biotoday/response49.htm)**b.** [repressors](http://novaonline.nvcc.edu/eli/biotoday/response49.htm)**c.** [inducers](http://novaonline.nvcc.edu/eli/biotoday/response49.htm)**d.** [promoters](http://novaonline.nvcc.edu/eli/biotoday/response49.htm)

**25. An operon is most closely associated with**  
**a.** [DNA replication](http://novaonline.nvcc.edu/eli/biotoday/response50.htm) **b.** [point mutations](http://novaonline.nvcc.edu/eli/biotoday/response50.htm) **c.** [translation](http://novaonline.nvcc.edu/eli/biotoday/response50.htm) **d.** [transcription](http://novaonline.nvcc.edu/eli/biotoday/response50.htm)

**References**

Molecular Genetics Quiz. http://novaonline.nvcc.edu/eli/biotoday/molecula.htm Accessed on 11/7/2011